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ABSTRACT

Two studies were conducted to compare experimentally the effects of teacher-led instruction and seatwork on acquiring mathematical concepts. In the first study, 255 fourth graders were assigned to groups to be taught a 15-minute teacher-led lesson only, a 15-minute lesson plus 12 minutes of teacher-led follow-up, or a 15-minute lesson plus 12 minutes of independent seatwork, each taught individually or in groups of 3 or 6. Group size affected both time-on-task and achievement. The hypothesized relationship between achievement and amount of teacher-led instruction was supported for children taught individually; length of teacher-led lessons appeared to be critical in determining achievement for groups of 3 and 6. In the second study, 108 fourth graders received a 15 minute lesson with no follow-up, a 30-minute lesson with 25% teacher-led instruction and 75% seatwork, a 30-minute lesson divided equally between teacher-led instruction and seatwork, or a 30-minute lesson with 75% teacher-led instruction and 25% seatwork. It was concluded that the more time spent in a sustained instructional activity, the greater is achievement. (MNS)

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# The Effects of Group Size, Instructional Method, and Mode of Responding on the Acquisition of Mathematical Concepts by Fourth Grade Students

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In the BTES studies, Fisher, Berliner, Filby, Marliave, Cahen, and Dishaw (1980) found that children in regular second and fifth grade classes spent 70% of instructional time in seatwork activities and 30% in teacher-led instruction. During seatwork, the children were engaged approximately 70% of the time; during teacher-led activities, engagement was greater (84%). The significance of these findings lay in the relationship between engagement and achievement: Fisher et al., reported that the amount of student engaged time was positively correlated with achievement. Consequently, it may be hypothesized that the more time children spend in teacher-led instructional activities, the greater will be their achievement. Stallings (1980) reported data that relate to this hypothesis. She found that time spent in teacher-led instructional activities was positively and moderately correlated with achievement and that time spent in noninteractive on-task activities (including seatwork assignments) was negatively correlated with achievement. Since both the BTES studies and the research conducted by Stallings were descriptive, the purpose of the studies reported in this paper was to compare experimentally the effects of teacher-led instruction and seatwork on the acquisition of mathematical concepts.

## Study 1

The objective of the first study was to compare the effects of three instructional methods on the acquisition of mathematical concepts taught to children either individually or in groups of 3 or 6.

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Two hundred twenty-five fourth grade students were assigned to groups to receive lessons taught in one of three ways: 15 minute teacher-led lesson only; 15 minute lesson plus 12 minutes of teacher-led follow-up; or 15 minute lesson plus 12 minutes of independent seatwork. Twelve students were assigned to each of the three cells at Group Size 1; nine groups to each cell at Group Size 3; and six groups to each cell at Group Size 6. The children were taught to solve four types of problems involving exponential notation by college students trained in the administration of the lessons. Posttest measures of achievement, observations of time-on-task, and frequency counts of opportunities to respond served as the dependent measures.

The analysis of the posttest achievement scores (see Figure 1) yielded a significant main effect for method and a significant method by group size interaction. Tests of simple effects showed that, within Group Size 1, the teacher-led follow-up group scored significantly higher than the independent seatwork group and that both scored significantly higher than the lesson only group. Within the teacher-led follow-up groups, Group Size 1 scored significantly higher than Group Sizes 3 and 6 which did not differ. Time-on-task during the lessons varied as a function of group size, with the smaller groups having greater time-on-task; during the follow-up the independent seatwork groups of sizes 3 and 6 had greater time-on-task than the teacher-led groups. The seatwork groups had more opportunities to respond during follow-up than the teacher-led groups.

Study 2

The results of this initial study supported the hypothesized relationship between the amount of teacher-led instruction and student achievement, but only for students who received individual instruction.

However, the power of teacher-led instruction was evidenced in a different way for groups of three and six. Although the groups that received seatwork follow-up had the highest mean scores, these means did not differ significantly from the mean scores of the groups that had teacher-led follow-up or no follow-up whatsoever. Consequently, it can be argued that for groups of three and six neither follow-up procedure resulted in significant increases in achievement beyond what the children learned during the 15 minute lesson. This non-effect occurred in spite of the facts that the length of the lesson was nearly doubled and the children were on-task for high proportions of time in both conditions (see Figure 2).

If the length of the teacher-led lesson is, in fact, the critical determinant of achievement, then longer lessons should produce greater learning. To test this hypothesis, a second study was conducted in which lesson format was manipulated so that only the proportion of teacher-led instruction (and hence seatwork) varied.

One hundred eight fourth graders were randomly assigned to receive one of four lesson formats: 15 minute lesson with no follow-up; 30 minute lesson divided into one-fourth teacher-led instruction and three-fourths seatwork follow-up (25%, 75%; 30 minute lesson divided equally between teacher-led and seatwork activities (50%, 50%); and 30 minute lesson divided into three-fourths teacher-led and one-fourth seatwork (75%, 25%). The lessons differed only in the way practice problems were presented; the longer the teacher-led lessons, the more examples the teacher presented. The lessons covered the same content (exponential notation) as those in the first study. Following each lesson, the children were posttested on a 48-item test covering the the four instructional objectives. In addition, observational measures of on-task behavior were obtained for a sample of all lessons on all lesson segments.

The analysis of the posttest scores yielded a significant main effect for Lesson Format and a nonsignificant effect for teachers (who were nested within Lesson Formats). THe Newman-Keuls follow-up tests on the Lesson Format means revealed that the mean score for the 75%, 25% group was significantly greater than either the 50%, 50%, or 15 minute lesson only formats, and that the 25%, 75% format was significantly greater than the 15 minute lesson format. There were no significant differences attributable to Lesson Format on time-on-task during either the teacher-led or seatwork lesson segments. These results are inconsistent with the hypothesized relationship between time in teacher-led activities and achievement. The predicted order of achievement was 75%, 25%, 50%, 50%; and 25%, 75%. The obtained outcome was 75%, 25%, 25%, 75%; and 50%, 50%, with the differences between adjacent scores failing to reach statistical significance.

The results of both studies are compatible with a second explanation: namely, that time spent in a single sustained activity is a more powerful explanatory variable than the nature of the activity. Thus, in the first study, the groups of one that received the lesson directed entirely by the teachers scored significantly higher than the groups whose lessons were either shorter or divided between two activities; in the second study, the groups that spent three-fourths of their lesson in either teacher-led or seatwork instructional activities scored highest. The conclusion that the more time spent in a sustained instructional activity, the greater the achievement is presently the best explanation for these results.

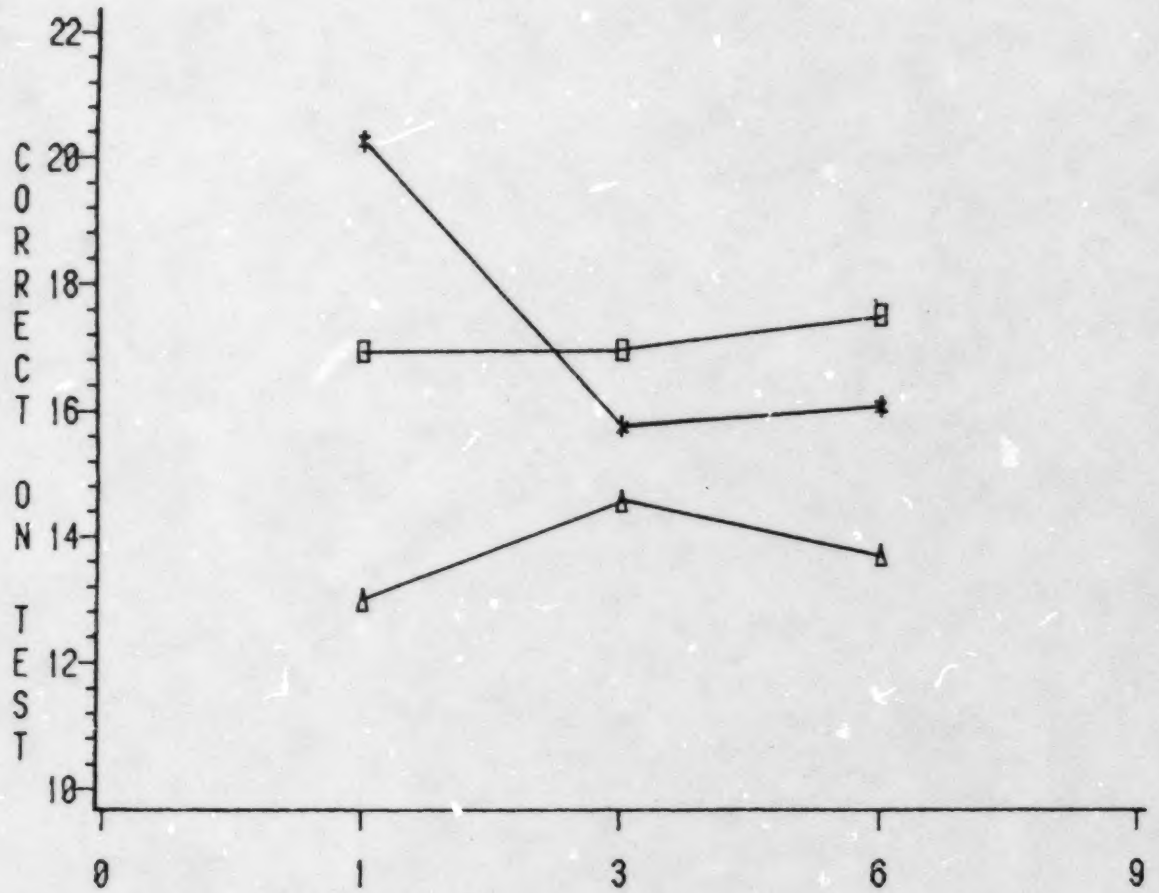
## Educational Significance

These studies are designed to address a question of practical significance to teachers who, it is well-known, rely heavily on both small group and seatwork during their daily programs of instruction. The studies

provide information on the appropriate lesson format for small group instruction; how structure interacts with group size; and how mode of responding during teacher-led recitation can a.rect acquisition. The research is also of importance because it advances findings established in correlational studies (Fisher et al., 1980; Stallings, 1980) by testing them empirically.

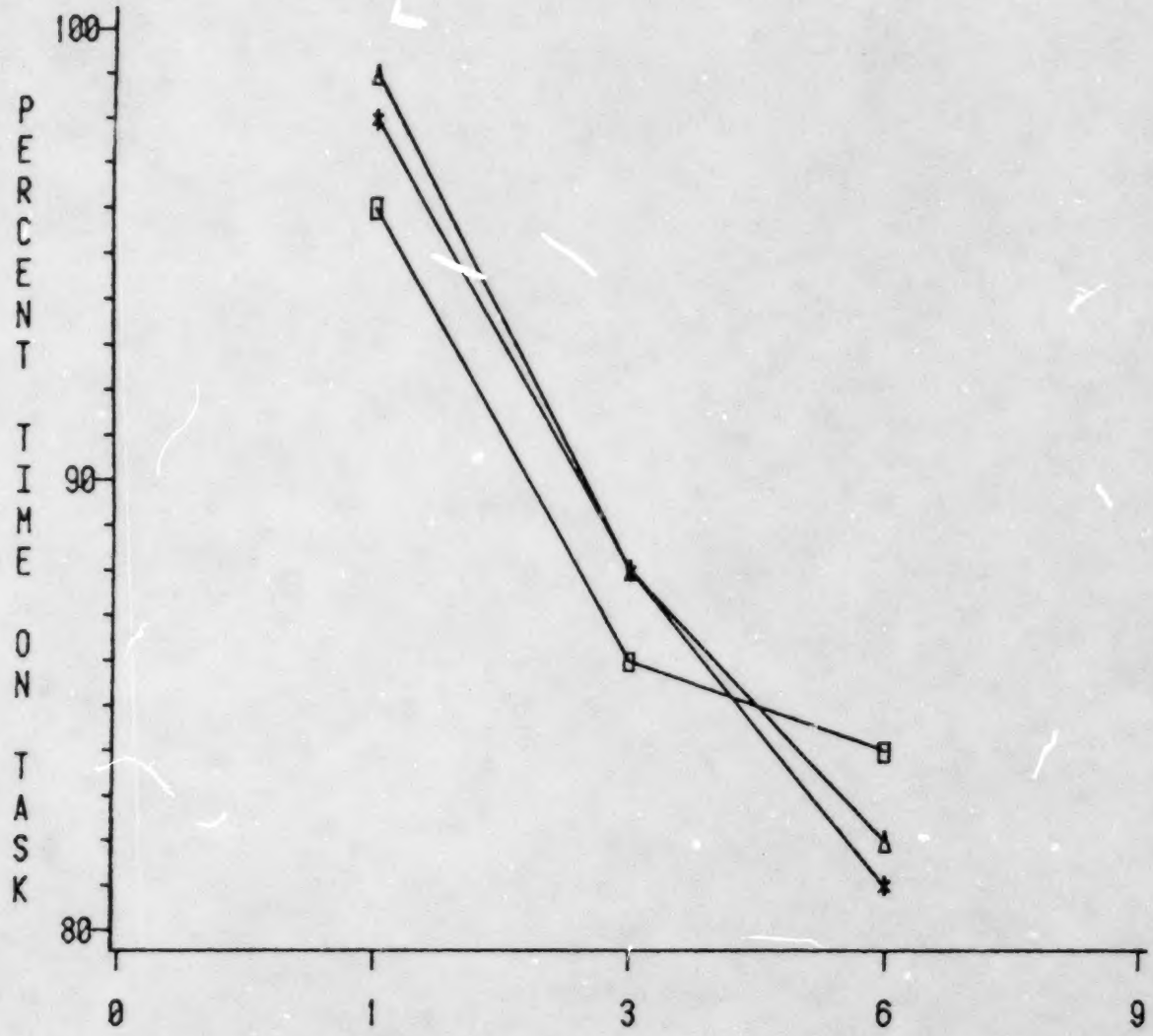
Faculty 3 - Sindelar M1

NUMBER CORRECT ON POST-TEST
BY GROUP-SIZE AND METHOD



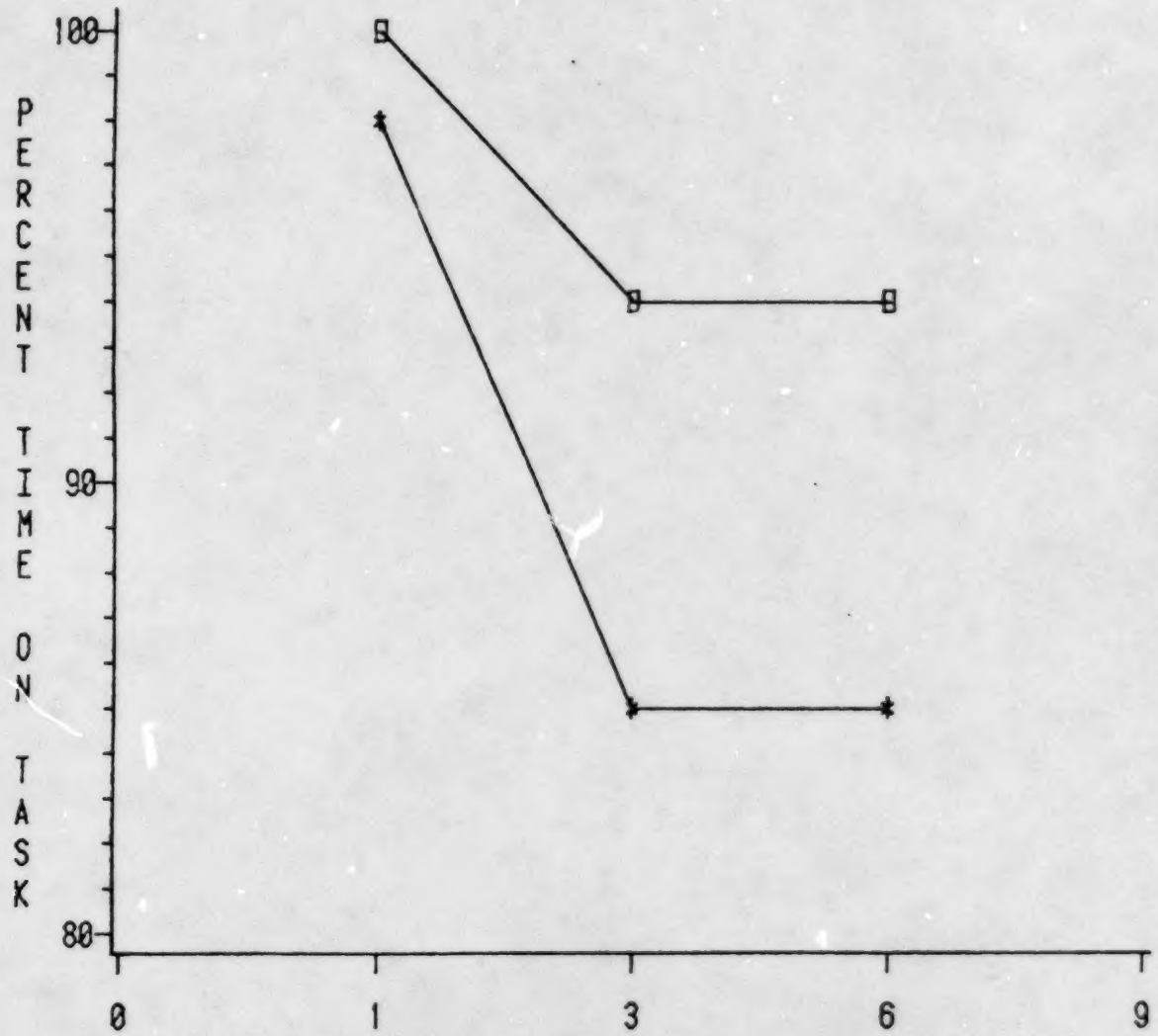

TRIANGLE IS LESSON ONLY
STAR IS LESSON PLUS TCHR-LED FOLLOW-UP
SQUARE IS LESSON PLUS INDEPENDENT SEATWORK

LESSON

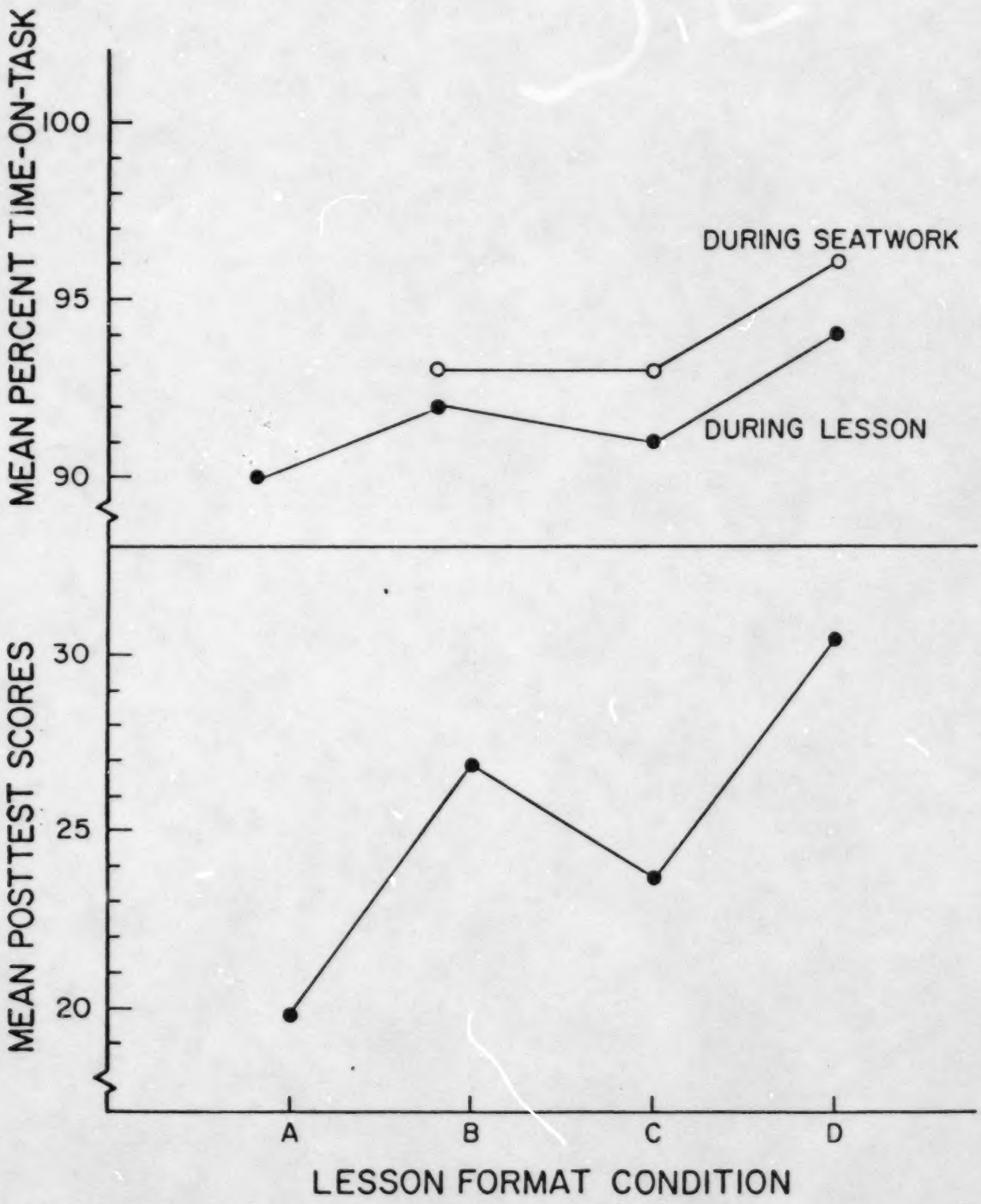



TRIANGLE IS LESSON ONLY
STAR IS LESSON PLUS TCHR-LED FOLLOW-UP
SQUARE IS LESSON PLUS INDEPENDENT SEATWORK

FOLLOW-UP




STAR IS LESSON PLUS TCHR-LED FOLLOW-UP
SQUARE IS LESSON PLUS INDEPENDENT SEATWORK


MEAN PERCENT TIME-ON-TASK
100
95
90
DURING SEATWORK
DURING LESSON
MEAN POSTTEST SCORES
30
25
20
A
B
C
D
LESSON FORMAT CONDITION